Reactor Neutrino Project Summary

The goal of the proposed experiment is to measure properties of the fundamental particle know as the neutrino. This experiment has been identified by a recent study of the American Physical Society as one of the most important next steps in the study of neutrinos. It will build upon the groundbreaking work that lead to the 2002 Nobel Prize in Physics, in which neutrinos were shown to have mass. In the proposed experiment, neutrinos from the reactor core will be detected at two locations. Neutrinos observed close to the reactors (about 200 meters away) will provide a precise measure of the flux. At a distance of about 1500 meters, a second set of detectors will look for a small deficit of neutrinos when compared to the near detector. The observation of a deficit will confirm the neutrino mass hypothesis and, if measured precisely, will allow us to determine the value of an elementary parameter in the standard model of physics.

Although the neutrino flux from the core is quite large (about 6×10^{20} per second) neutrino interactions are very rare and their signal is small. Therefore the detectors need to be shielded by a significant amount of dirt and rock to block out most of the cosmic radiation that would otherwise swamp the detectors. To achieve this, we plan to dig shafts, at both the near and far sites, down to a depth of about 180 meters. At the bottom of each shaft, we will excavate rooms for the detectors. In order to accurately calibrate the detectors they will periodically be moved between the near and far site. The detectors will likely be spherical in shape with a diameter of up to 6.5 meters and weight about 150 tons. Therefore moving the detectors may require an upgrade of existing roads or the creation of a new road to connect the near and far sites. We estimate that the civil construction of this proposed facility will take about two years and cost $25 to $30 million. All costs would be paid by the National Science Foundation, the U.S. Department of Energy, and the participating universities.

We are currently in the final stage of our year long study of the feasibility of Braidwood Nuclear Station for this project. The last step is to drill bore holes down to the required depth to determine if the rock conditions are suitable. All geological data that we have reviewed (including data from the Byron & Braidwood UFSAR) indicates that the rock layer at 180 meters should work. Still we must confirm that the rock strength is sufficient to support our excavation, and that the water flow rate will be manageable. The bore hole drilling should take two weeks and the costs will be covered by the University of Chicago, which is prepared to put the bore hole project out to bid as soon as it receives permission to proceed.

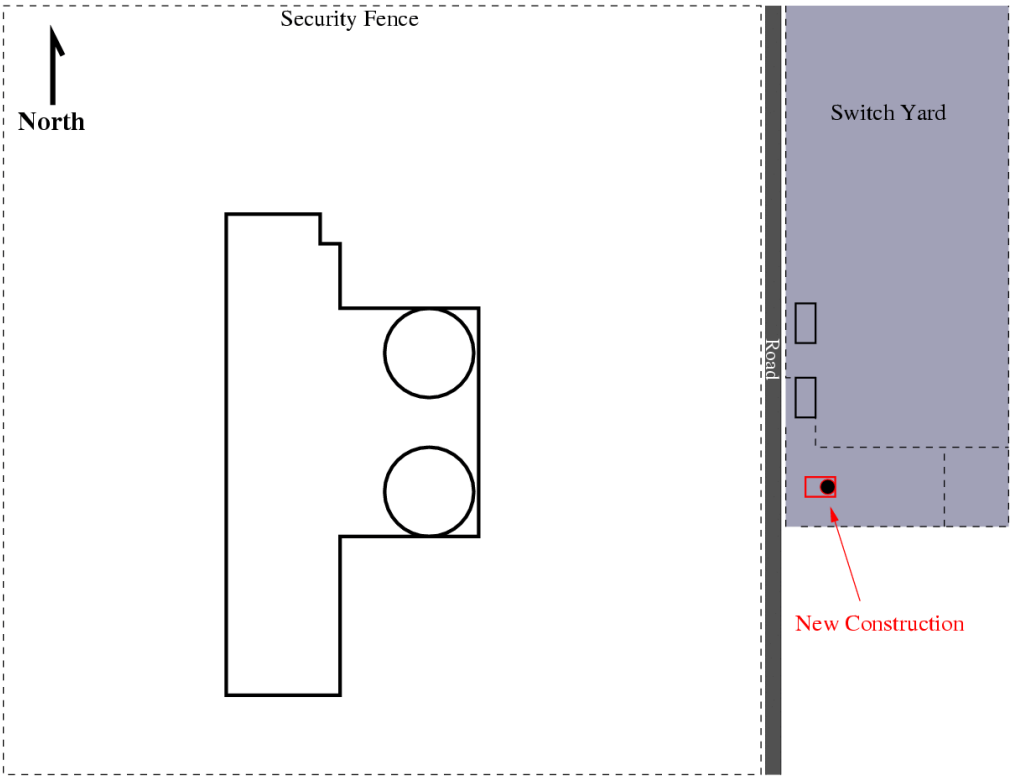

Figure 1: The anticipated location and size of the near detector shaft and support building with respect to the reactor cores, security fence and switch yard.

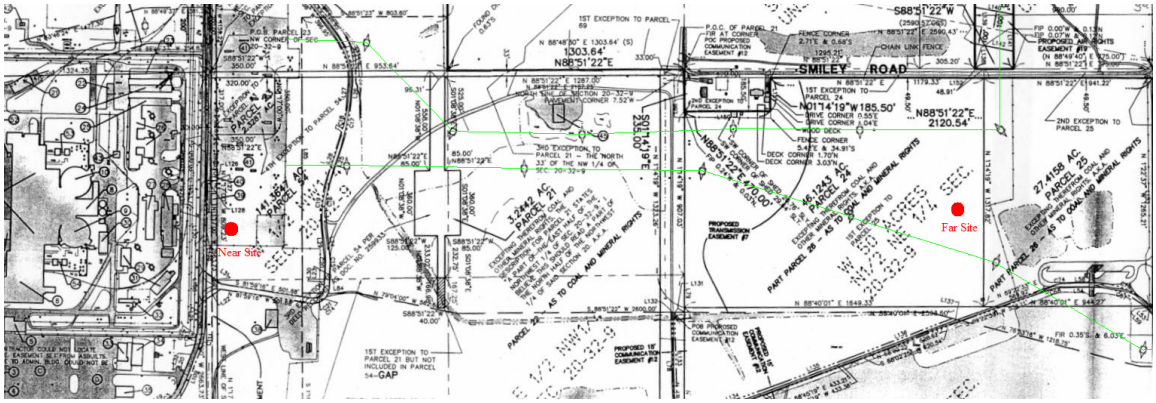

Figure 2: This section from the SDI Consultants Land Title Survey shows the proposed locations for the near and far shafts. The far shaft about 400 meters from the nearest residence and is also located outside the existing wetlands areas to the east. Overhead high voltage lines, which were a consideration in locating the far shaft, are shown in green.

Reactor Neutrino Collaboration

INSTITUTIONS

Argonne National Laboratory

Brookhaven National Laboratory

Columbia University

Fermi National Accelerator Laboratory

Kansas State University

MIT

Oxford University (UK)

University of Chicago

University of Michigan

University of Pittsburgh

University of Sussex (UK)

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